SCIENCE.

FRIDAY, JUNE 19, 1885.

THE LICK OBSERVATORY.

The Lick observatory, in its present condition on the summit of Mount Hamilton, California, is so nearly completed, with the exception of the great telescope, that the institution may now be sketched to advantage in its permanent form. In an early issue of *Science*, therefore, this enterprise will be traced through its various stages, from the inception onward. Astronomers have been slow to avail themselves of the great advantages of mountain elevation and isolation in the prosecution of astronomical research, partly because of the pecuniary outlay attending the necessary expeditions, but chiefly because some of the earlier expeditions to mountain summits were not attended with results of especial importance, and, on good theoretical grounds, the meteorological conditions of such stations appeared likely to be so unfavorable as to counterbalance fully the advantages to be derived from mere elevation. And besides, the evidence derived from the two most famous expeditions — that of Prof. C. Piazzi Smythe to the Peak of Teneriffe, and of Mr. William Lassell to Malta — was so contradictory in character as to afford very good ground for abandoning the hope of immediate advantage to astronomy from superior elevations.

It is not possible to say how far Mr. James Lick was acquainted with these endeavors of scientific men; nor need the immediate circumstances or events which impelled him to his extraordinary astronomical bequest be considered here. Professor Newcomb points out the fact that his movement followed close upon the completion of the great Washington telescope in 1873, then the largest in existence. Had Mr. Lick known the opinions of the best astronomers on the subject of mountain observatories, and the likelihood of securing, on elevated and isolated peaks, results at all commensurate with the trouble and expense of occupying such stations, he would have found very little to encourage the project. In this case, however, as very often before, a little experience has proven to be worth more than an indefinite amount of scientific theorizing. It has been said that the scheme of building "a powerful telescope, superior to and more powerful than any yet made," was the nearest of all to the heart of Mr. Lick: there is abundant evidence that this is true; and it may be also true that he regarded the observatory as an appendage of the telescope. But the course of subsequent events has proven it a matter for sincere gratulation in astronomical circles, that he ever regarded either the observatory or the telescope at all; for, had not the prospective researches with the great telescope arrested his attention, there is very little reason for believing that, in so far as he was concerned, astronomical science would ever have been in a position to reap benefit from the splendidly equipped observatory which already exists on the summit of Mount Hamilton.

That Mr. Lick was bound, heart and soul, in the project, not only of a great telescope, but of the best possible location for it, is evident from the fact, that when nearing his eightieth year, and although oppressed with physical infirmity, he resolutely undertook a wagon-journey of some forty miles or more, reclining on a mattress, all for the sake of investigating a proposed mountain site in person. His solicitous concern for the enterprise was very marked. Those who knew him best say, that, if his practical knowledge of astronomy had been greater, he would have given every penny of his vast fortune for the great telescope, and the observatory and its endowment. He would have recognized, too, the great improbability of such an institution being completed within a period of a few short years,

and would thus have been led to provide for the reasonable use of the instrumental equipment as fast as it was put in place on the mountain. The failure to make such provision constitutes the chief point of unfavorable criticism on the part of astronomers, and is in many respects unfortunate; but sundry advantages also have arisen from it, which may be recognized with more profit, particularly as this condition of things must remain unalterable until the great telescope is completed, and the entire institution comes under the administration of the University of California, in full accord with the terms of Mr. Lick's bequest.

Five years ago no one could have anticipated that the year 1886 must pass with the great telescope still unfinished. It is worthy of note, however, that, while the delay in obtaining the necessary glass for the objective has proven so great an embarrassment to the work of the opticians, it has not as yet sensibly impeded the progress of the construction of the observatory itself. To this fact we alluded at page 377 of the current volume of *Science*, stating as well the very reasonable grounds for the belief that the plans of the Lick trustees, in so far as they pertain to the construction of the great telescope and the conjoined observatory, will be completely executed at the close of the year 1887. With its unparalleled instrumental-equipment, and an unusual endowment for the prosecution of astronomical research; located where the sky is cloudless most of the year, and at such an elevation as to be above the clouds a great part of the remainder; and situate in a region, too, where the steadiness of the air permits astronomical measurement of the highest precision to proceed uninterruptedly throughout the entire night for months at a time, — the Lick observatory is destined, under prudent management, to take its place at once in the foremost rank; and, although it is the first established mountain observatory, it may well expect to hold its own in the emulation of similar institutions which may subsequently be inaugurated at greater elevations.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

A new standard cell.

SINCE October last I have made some experiments on the zinc-alkali-copper oxide cell with a view to determine the practicability of some modification of it.

The fact that copper and iron, and perhaps some other metals, dissolve in potassium (or sodium) hydrate when used as cathodes, suggested to me the possibility that the formation of the alkaline cuprate might occur at a definite and practically convenient difference of potential between the electrodes immersed in the alkaline bath. As a matter of fact, I find that a cell mounted with amalgamated zinc, potassic hydrate, and metallic copper, gives, when charged until a blue color appears, a deflection of a hundred and seventy divisions on the scale of a Thompson galvanometer; the Daniell, mounted with saturated zinc sulphate and copper sulphate, giving a hundred and fifty-six divisions. The zinc-alkali-copper cell is joined by a double key to charging-cells and to the galvanometer, a resistance of over nine thousand ohms being included in the circuit of the latter.

The proper shunt is, of course, employed. This deflection of a hundred and seventy divisions seems to be invariable, and the cell experimented upon promises to be a desirable practical standard of electromotive force. Its excellence appears to consist in the fact that the cuprate produced breaks up before it diffuses to the amalgamated zinc, depositing oxide of copper, which settles. The zinc is suspended about an inch above the copper, — which is a spiral ribbon, exposing about two square feet of surface, — and the resistance is less than an ohm. I have used a ten-per-cent solution of 'depurated' potassic hydrate. After some trials, it is found that the shifting of the cell from the charging source to the galvanometer circuit may be done leisurely, as the electromotive force does not seem to begin to fall off for some minutes. Further testing of the effect of changes of temperature, strength of solution, etc., is in progress. Thus far, the temperature of the cell has been allowed to vary very little, not enough to affect the readings. I offer this preliminary note as of possible interest to your readers. This type of cell would be admirably adapted to furnish any desired multiple of its electromotive force.

F. C. VAN DYCK.

Rutgers college, New Brunswick, N.J.
June 13.

Real and imaginary Americanisms.

Your correspondent, whose identity is perhaps scarcely concealed by initials, is quite right in saying (*Science*, June 5, 1885, p. 454) that the peculiar use of 'get' in Sir William Thomson's lecture is not an Americanism. But he is not equally correct in his remarks concerning 'would' and 'should.' It is true that speakers in the west of this country are apparently unable to use these words as they are used by writers of classical English, but the same peculiarity is one of the most marked characters of the English of Scotland, as shown in the current burlesque of it: 'I will be drowned, and nobody shall save me.' The confusion may be reaching England, as your correspondent remarks, but not from America. Sir W. Thomson has not 'caught the prevalent epidemic:' it was doubtless born and bred in him.

E. W. C.

THE GINKGO-TREE.

An event of considerable interest to botanists has just occurred at Washington in the flowering, for the first time, of two of the ginkgo-trees in the U. S. botanic garden.

In passing the grounds on Saturday evening, May 6, after the gates were closed, my attention was attracted to a tree standing just inside the enclosure, which, though as yet nearly leafless, was loaded with staminate aments borne in terminal clusters on very short branchlets all along the branches, even down to the base of the larger ramifications. A glance showed that it was a ginkgo, though I had never seen one in flower before; and, after examining it sufficiently, I went away, and was obliged to wait until Monday morning before I could notify the superintendent, Mr. W. R. Smith, and institute a search for other trees in the same condition.

Presuming that, as is usually the case in public gardens and parks, all the trees in the city would also be males, so that no opportunity would exist for witnessing the fruiting of this tree, I was most agreeably disappointed when I learned that Mr. A. L. Schott had found another tree in flower in the same enclosure, and that this tree was a female. I thereupon carefully inspected both these trees, and found that anthesis was so nearly synchronous in the two sexes that I was able on the 5th to pronounce them ready for fertilization. But as they stand some seventy-five yards apart, with the superintendent's house and other obstacles between them, it was evident that this could not take place unaided; and accordingly, with the hearty co-operation of Mr. Smith, the work of artificial pollinization was undertaken. This has been repeated several times at different hours of the day, and so thoroughly performed that it is hoped the result will be successful,[1] and that fruit will be borne this season.

The so-called Japanese ginkgo,[2] or maiden-hair tree (Ginkgo biloba, Linn.; Salisburia adiantifolia, Smith), is one of the most interesting trees that have been introduced into the landscape plantations of Europe and America. Although possessing deciduous foliage and broad green leaves, it nevertheless belongs to the Coniferae, though its affinities with the rest of that family are anomalous, being closest with the yew tribe. An examination of its leaves shows them to be wholly unlike those of any other phenogamous plant. They are deltoid in outline, and the fine nerves that run from the narrow base to the broad apex fork several times in their course, after the manner of ferns. In fact, a ginkgo leaf very closely resembles a much enlarged and thickened pinnule of the maiden-hair fern (Adiantum), — a resemblance which not only suggested to Smith the specific name adiantifolia, but has caused the tree to be popularly called in some localities the maiden-hair tree.

A study of the paleontological history of this remarkable plant reveals the fact that it is an archaic form, and the sole survivor of an otherwise extinct type of vegetation which had numerous representatives in the remote geologic past. The Salisburia adiantoides of Unger, found in the upper miocene of Senegal, is not essentially different from the living species; and Professor Heer detected it again in the miocene strata of Greenland. In 1881 I was so fortunate as to obtain from Laramie strata at Point of Rocks Station, Wyoming Territory, a form which, except for its smaller leaves, appears to be identical with the living one; and in 1883 I found in Fort Union strata, on the lower Yellowstone, a slightly different form, with larger leaves, showing no lobes, proving that the present living form has come down to us, almost unchanged, from a period as remote at least as the cretaceous age. But other and distinct forms are found in the cretaceous, and still others, showing greater and greater divergence, as far back as the Jurassic; those of the oolite bearing clear evidences of having been derived from a series of still older, digitate-leaved forms (Jeanpaulia, Baiera, etc.) whose relationship with the ginkgo was not suspected until these intermediate ones had been brought to light by Heer from the mesozoic rocks of Spitzbergen and Siberia. In fact, until recently these earlier Jurassic forms, which had been long well known, were from their nervation referred to the family of ferns; as, indeed, a fossil leaf of the ginkgo would probably be now, if the living plant were unknown.

But even this is not all. By another series of far more ancient forms (Trichopitys, Psygmophyllum, Noeggerathia), this persistent type may be traced still farther back, even across the boundary between mesozoic and paleozoic time, until, in the great carboniferous flora, it has been connected, almost without

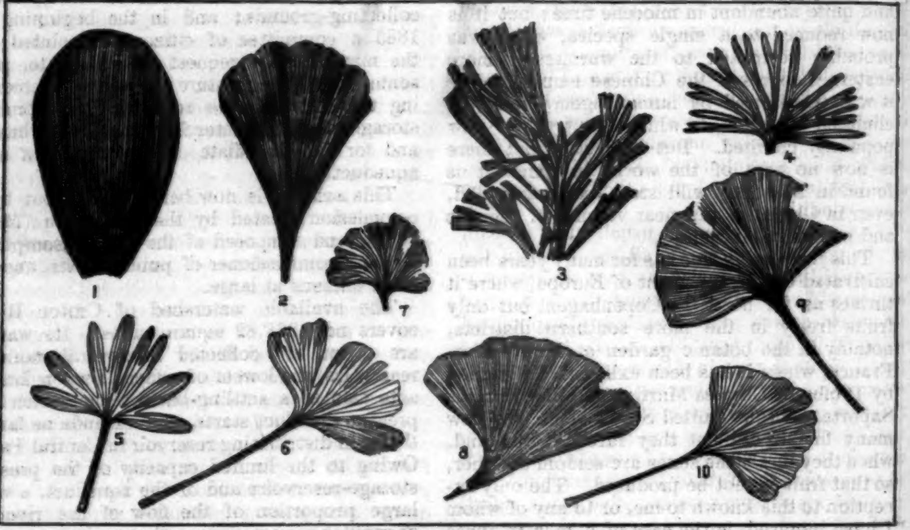
[1] Evidence is abundant (June 15) that artificial pollinization was successful.

[2] The orthography of this word is not settled. Linné (Mantissa plantarum, Holmiae, p. 313) wrote *ginkgo*, as did also, apparently, Kaempfer before him (Amoenitat. exotic., 1712), and as all botanists since have done, and do still; but nearly all lexicographers reverse the consonants, and write *gingko*, usually without explanation. Littré alone, of all I have consulted, gives both spellings. In the supplement to Webster's dictionary the word is said to signify silver-fruit, and it would seem that the etymology ought to determine the orthography.

question, with the abundant and so long enigmatic Cordaites. This ancient plant was formerly regarded as the forerunner of the family of cycads; but now, in the light of these discoveries, it is almost universally regarded as coniferous. It was one of the earliest types of land vegetation to appear on the globe, running far back into Devonian, and even into Silurian time.

The figures of the accompanying plate, kindly drawn for me by Ensign Everett Hayden, U. S. navy, have been selected with a view to illustrating the phylogeny of the genus Ginkgo: and they are numbered, and as nearly as practicable arranged upon the plate, in the order of supposed development, from the true Cordaites to the living Ginkgo biloba; this being also, as will be observed, substantially the chronological order of their appearance.

The broad leaves of some species of Cordaites, though more or less elongated or elliptical in shape, possess a nervation strikingly similar to that of the later ginkgo-like forms; while the familiar fruits so abundant in the coal-measures, and which are now known to be those of Cordaites, resemble in an equally remarkable manner the almond-shaped nuts borne by the present maiden-hair tree.



PHYLOGENY OF THE GENUS GINKGO.

1. Cordaites lingulatus, Grand'Eury: carboniferous, Central France. 2. Psygmophyllum (Noeggerathia) flabellatum (Lind. & Hutt.), Schimp.: carboniferous, England. 3. Ginkgophyllum Grasseti, Saporta: Permian, Hérault. 4. Baiera (Jeanpaulia) Münsteriana (Presl), Heer: rhaetic, Bayreuth. 5. Ginkgo Sibirica, Heer: oolite, Siberia (restored by Heer). 6. Ginkgo digitata (Brongn.), Heer: oolite, Cape Boheman, Spitzbergen. 7. Ginkgo Laramiensis, n. sp.: Laramie, Point of Rocks, Wyoming Territory. 8. Ginkgo (Salisburia) adiantoides, Unger: Fort Union beds, lower Yellowstone. 9. Ginkgo (Salisburia) adiantoides, Unger: miocene, Greenland. 10. Ginkgo biloba, L.: living, Washington, D.C. All the figures are reduced one-half.

Though these carboniferous plants were at first commonly regarded as cycadaceous, still the long, ribbon-like leaves of certain cordaitean forms (Poa-Cordaites of Grand'Eury) led some eminent authors, including the late Professor Göppert, to consider them monocotyledonous, and the precursors of our lilies, reeds, grasses, and also of the palms. But even these mistakes have not been without their uses. It is the peculiarity of science that in its very errors knowledge is extended. The theory that Cordaites was cycadaceous was not wholly false; the suggestion that it might be monocotyledonous contained a 'soul of truth;' and the present opinion that it was coniferous is, I venture to assert, not wholly true. The truth lies in the midst of all these opinions. It seems to be this: there were no true paleozoic Cycadaceae, monocotyledons, nor Coniferae; but Cordaites was the prototype of them all. It was in the Trias, whose flora is unfortunately the least known of all the formations in past time, that all these definite types of vegetation were differentiated from this comprehensive type, — the Cycadaceae through their Macropterygiums

and Pterophyllums; the monocotyledons through their Aethophyllums and Yuccites; and the Coniferae through their Albertias, Walchias, and Voltzias; while the less modified ancestral type, which began even in the Permian to assume a distinct Salisburian aspect in the genus Ginkgophyllum, has come down to us, as already described, through the several successive modifications which culminated early in the tertiary in the modern form. This general form was somewhat varied, widely distributed, and quite abundant in miocene time; but it is now reduced to a single species, which was probably restricted to the warmer or more eastern districts of the Chinese empire before it was transferred by human agency, and acclimated in Japan, to which country it is now popularly credited. But it is said that there is now no part of the world in which it is found in a strictly wild state, being confined, even in China, to the near vicinity of temples and human habitations.

This interesting tree has for many years been cultivated on the continent of Europe, where it thrives as far north as Copenhagen, but only fruits freely in the more southern districts, notably in the botanic garden at Montpellier, France, where it has been exhaustively studied by Professor Charles Martins and the Marquis Saporta. In the United States there are now many fine trees; but they rarely flower, and, when they do so, the sexes are seldom together, so that fruit cannot be produced. The only exception to this known to me, or to any of whom I have inquired, is the case of a pair of these trees in the grounds adjacent to the University of Kentucky at Frankfort, which are in such close proximity to each other that fertilization regularly takes place, and fruit is borne.

It is owing to these circumstances that such special interest attaches to the coincident flowering this season, for the first time, of the pair of maiden-hair trees in the botanic garden at Washington; and the rare opportunity, should it be afforded, of witnessing all the steps in the reproductive process of this historic type of vegetable life, will be appreciated by both botanists and vegetable paleontologists.

LESTER F. WARD.

THE NEW CROTON AQUEDUCT.

THE necessity for an addition to the present supply of water of New York has been felt for many years, and the present Croton aqueduct, finished in 1842, has become entirely inadequate to meet the present requirements of the city. Never was the need of an additional supply better illustrated than in 1880, when the authorities in charge stated, at the end of a prolonged drought, that there was only fifteen days' supply at hand. Timely rains occurred shortly afterwards, and replenished the water-sources.

Since 1875, when two projects were presented for an additional water-supply, numerous surveys were made, extending in several instances beyond the limits of the present collecting-grounds; and in the beginning ot 1883 a committee of citizens, appointed by the mayor at the request of the senate, presented to the legislature a report recommending that provision be made for the ultimate storage of all the water from the Croton basin, and for the immediate construction of a new aqueduct.

This scheme is now being carried out by a commission created by the legislature (May, 1883), and composed of the mayor, comptroller, and commissioner of public works, and of three citizens at large.

The available watershed of Croton River covers now 338.82 square miles. Its waters are at present collected in several storage-reservoirs, the lowest of which (Croton Lake) acts also as a settling-basin, from which the present aqueduct starts, and extends as far as the main distributing reservoir in Central Park. Owing to the limited capacity of the present storage-reservoirs and of the aqueduct, a very large proportion of the flow of the river is unavoidably wasted over Croton dam.

The present scheme consists in building reservoirs capacious enough to impound the copious spring flows, and in constructing a larger aqueduct, through which the necessary allowance of water can be drawn all the year round from the new reservoirs. It is consequently, in a general way, on a larger scale, a duplicate of the present system; but the very scale on which the work is to be built gives rise (as may be understood from the short description which follows) to many interesting and difficult engineering problems.

It is estimated, that, in the dryest years, the Croton watershed can furnish a daily supply of 250,000,000 gallons, equivalent to 100 gallons per head per day for a population of two million and a half souls, or to 75 gallons per head for a population of three and one-third millions.

In order to store the large amount of water necessary to provide this large daily supply during the dryer months, it has been found advisable to provide, at first, one reservoir of

very large capacity, placed low enough in the Croton valley to increase to 361.82 square miles the available area of the watershed of Croton River. This reservoir is to have a capacity of 3,200,000,000 gallons, — a body of water which would cover 9,400 acres ten feet deep.

The dam which is to form this reservoir (the Quaker-bridge dam), 178 feet high above the bed of the river, is to be built of solid masonry, and the water behind it is to be 171 feet deep. As the foundations of the dam must be extended to the bed-rock, a distance of nearly 100 feet below the bed of the stream, the total height of the masonry structure will consequently be not far from 300 feet for a length of 400 feet in the deeper portion of the valley. On both sides of this deeper portion the rock-bottom rises gradually, and the total length of the dam is to be about 1,300 feet.

The height mentioned for a masonry dam is unprecedented; and the strains which will be transmitted to the base of the structure by the combined action of its own weight and of the water-pressure are such as to require in the design a departure from the methods used and recommended by the engineering authorities who have studied the question of high masonry dams of lesser magnitude. The width of the dam at its base, although not fully decided upon, is to be more than 200 feet.

The question of providing an overflow to liberate the surplus water which must be wasted over the dam is happily and economically solved by nature, which has provided in the immediate vicinity a depression in the rock-formation, of the required elevation and form for the safe disposal of the freshets.

The new aqueduct starts from a point near the present Croton dam, and follows a general southerly direction towards the city, to 135th Street, with a length of nearly thirty-one miles. For the remaining distance, from 135th Street to the reservoir in Central Park (two and one-third miles), the water is to be conveyed in pipes. Harlem River is crossed by means of an inverted siphon 150 feet below the water surface.

With the exception of three points where it comes to the surface of the ground for short distances, the aqueduct is to be wholly in tunnel; and from the indications furnished by the topographical character of the country, and by numerous borings made with the diamond drill, it is probable that the excavation is to be, almost for the whole length of the aqueduct, in solid rock. It is expected that a large proportion of the tunnel excavation is to be lined with masonry; but, wherever the character of the rock is such that it can remain exposed without danger of falls, the masonry is to be dispensed with. If the line of work had been so located as to allow of the construction of the aqueduct in open trenches of moderate depth, it would have been much longer, owing to the necessity of following the contours of the land; and it would have passed along the east shore of Hudson River, through thickly settled communities, where the land-damages would have been much higher. The tunnel presents also the important advantage of being almost wholly safe from the attacks of a mob or of a military foe.

From Croton dam to a point south of and near the boundary of the cities of Yonkers and New York, the aqueduct has a maximum flowing capacity of 320,000,000 gallons per day: it is 13.6 feet high and 13.6 feet wide; and its section is that of a semicircular arch, supported on slightly concave sides, the bottom being formed by a flat inverted arch.

At the point just mentioned, where it is expected that a large distributing reservoir is to be built to supply the annexed district, and where consequently a portion of the supply is to be diverted, the flowing capacity of the aqueduct is reduced to 250,000,000 gallons per day, and its form is circular, with a diameter of twelve feet three inches.

This part of the aqueduct, over six and a half miles in length, including the inverted siphon under Harlem River, is to be heavily lined with masonry; and, owing to the insufficient elevation of the land, it is depressed to a considerable depth, presenting the peculiar, and to a certain extent experimental, feature of a masonry channel built in solid rock, and subject to a considerable internal water-pressure. Its prototype, the tunnel under Dorchester Bay, which conveys the sewage of Boston to Moon Island, has been in successful operation for more than a year, but under somewhat different conditions of location, size, and pressures.

For the purposes of construction and of future maintenance of the aqueduct, thirty-two shafts are provided, of various depths, the greatest being 350 feet. Twenty-four shafts are under construction, twelve of which are already completed, or nearly so.

Six extensive gate-chambers are to be constructed, in connection with the aqueduct, for the purpose of emptying it when necessary, and of regulating the flow of water from the

storage-reservoir into the city. One of them, at the head of the aqueduct, near Croton dam, is to be of unusual size, and is to be constructed to support a maximum pressure of 65 feet of water.

The aqueduct from Croton dam to Harlem River is now under contract to the amount of $11,900,000. The rest of the work is to be commenced shortly. A. FTELEY, C.E.

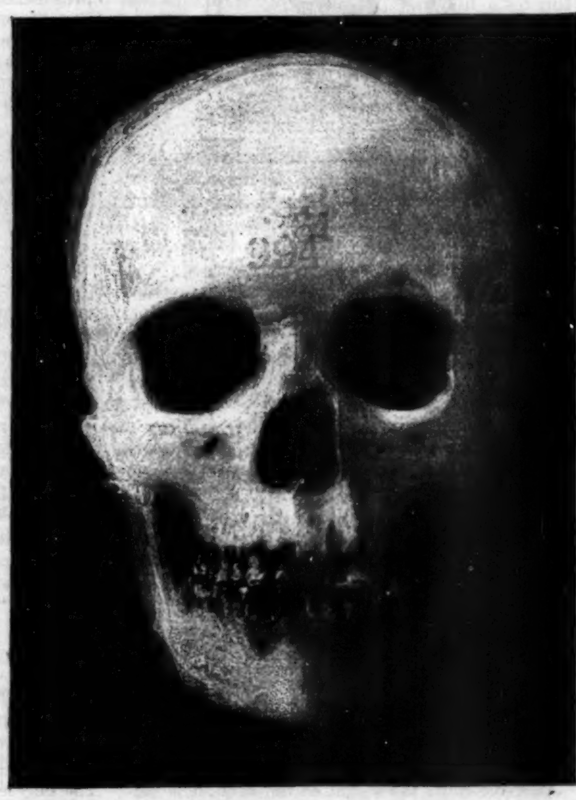
MEASURING THE CUBIC CAPACITY OF SKULLS.[1]

IN referring to the application of composite photography to craniological studies, Dr. Billings described the methods employed at the army medical museum in the preparation of such composites. They are made directly from the skulls, and not by combining separate pictures of individual crania. The skulls are adjusted in succession on the object-stand, in such a manner that the horizontal datum-plane adopted by German craniologists, and the subnasal and maximum occipital points (or the supra-auricular points in profile exposures), shall coincide; this being effected by movable frames on which are stretched a series of vertical and horizontal threads. It is very desirable that some uniform scale for the preparation of such photographs should be agreed upon by craniologists before the preparation of extended series is undertaken, and one-half of the natural size is suggested for this purpose.

These composite photographs should be studied in connection with the measurements of the crania included in them. It is a rapid and convenient means of obtaining graphic representations of a series of irregular objects, — representations which shall indicate not only the mean, but also, as far as possible, the maxima, of variations.

While something has been done in the study of the internal configuration of the cranial cavity, and more especially of the various fossae and projections at its base, with reference to their difference in various races, this field of inquiry is as yet comparatively unworked; and Dr. Billings thinks it very desirable to follow out this special line of investigation in connection with the large and valuable collection of crania of American races which now exists in the army medical museum and in the national museum. To do this, however, it is necessary that sections should be made of the skulls; and, before making such sections, it is desirable that all measurements, and especially the measurements of cubic capacity of these crania, should be made according to the best and most approved methods, and the results carefully recorded.

From the results of preliminary experiments upon the methods in use for measuring the cubic capacity of crania, Dr. Billings became dissatisfied with their accuracy, and accordingly requested Dr. W. Matthews to undertake a series of experiments for the purpose of obtaining, if possible, some more accurate and reliable method of ascertaining the cubic capacity. The following is an abstract of the report of Dr. Matthews, giving the results of his observations and experiments on measurements by means of water.

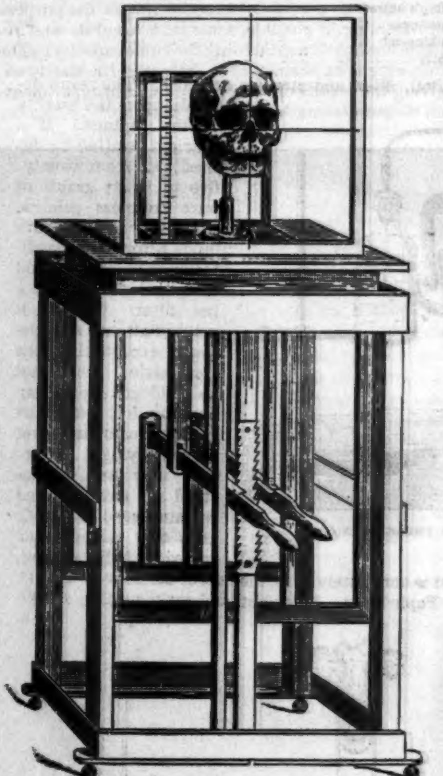


SIX ADULT MALE ANCIENT CALIFORNIANS FROM SAN NICHOLAS ISLAND.
Exposure of each skull 10-30 seconds, according to color.

Hitherto anthropologists have chiefly employed solid particles, such as shot or seeds, in the cubature of skulls. Water has been tried by former experimenters without success. Dr. Topinard, in his 'Élé-

[1] Abstract of a paper read to the National academy of sciences by Dr. WASHINGTON MATTHEWS, U.S.A. Presented, with introductory remarks, by Dr. J. S. BILLINGS, U.S.A.

ments d'anthropologie générale' (Paris, 1885), states that the chief difficulties with water are: first, that the water, wetting the sides of the measuring-glass, rises on it, and makes it impossible for the observer to read correctly; and, second, that the water penetrates to the sinuses and vacuoles of the skull, and returns, when the skull is drained, to augment unduly the water belonging to the cavity proper. The experiments of Dr. Matthews indicated that the great-



ELEVATING-TABLE, CRANIOPHORE, AND CROSS-LINE FRAME FOR ADJUSTING SKULLS IN COMPOSITE PHOTOGRAPHY.

est source of uncertainty lay in the fact that the skull, when moistened, increases rapidly in cubic capacity. His method is as follows: —

After recording the weight of the skull, it is varnished inside with thin shellac varnish, applied by means of a reversible spray apparatus. Artificial or accidental orifices are closed with India-rubber adhesive plaster. The foramina and fossae are filled with putty. The skull is wrapped in a coating of putty an inch or more in thickness, which renders it water-tight. It is filled with water by special apparatus; in forty-five seconds, and emptied in fifteen seconds. The rapidity of this manipulation, in conjunction with the varnishing, prevents soaking into the sinuses, and the undue measurement of water which does not pertain to the cranial cavity. The water is poured into a measuring-glass of two thousand cubic centimetres capacity, and lycopodium is scattered on the water to define the true surface. The putty is taken from the skull: the latter is cleaned, and placed in a dry, warm apartment, until by slow evaporation it has been reduced to its former weight, and consequently to its former capacity. Then it is measured a second time to verify the results of the first measurement. The author did not claim rapidity as an advantage of the system, but believed that it removed to a great extent the effect of varying muscular effort, which was such a disturbing factor in other methods. "With the most important operations, the unchangeable element of time takes the place of the fickle element of vital force."

Although the method is new, and still susceptible of improvement, it is thought that the results as shown in the following table have not been excelled.

Comparative measurements of varnished and unvarnished skulls.

	Museum number of skull.	UNVARNISHED. First measurement.	UNVARNISHED. Second measurement.	UNVARNISHED. Difference.	VARNISHED. First measurement.	VARNISHED. Second measurement.	VARNISHED. Difference.	Date of measurement.	
		C.C.	C.C.		C.C.	C.C.			
1	199	1,400	1,390	10	1,400	1,400	–	March 20	April 2
2	359	1,450	1,445	5	1,450	1,450	–	" 23	" 3
3	362	1,275	1,270	5	1,270	1,265	5	" 26	" 2
4	373	1,455	1,455	–	1,450	1,450	–	" 24	" 2
5	375	1,305	1,305	–	1,300	1,300	–	" 24	" 3
6	481	1,455	1,455	–	1,445	1,445	–	" 24	" 2
7	1,516	1,160	1,155	5	1,160	1,160	–	" 23	" 3
8	1,914	1,285	1,280	5	1,285	1,285	–	" 27	" 3
9	1,915	1,450	1,440	10	1,440	1,435	5	" 21	" 2
10	2,054	1,200	1,195	5	1,190	1,190	–	" 26	" 2
Sum of difference.				45	. .	. .	10		

Average variation in unvarnished skulls . . . . 4.5 c.c.
Average variation in varnished skulls . . . . 1.0 c.c.

THE CULTIVATION OF MICROBES.[1]

IT is possible to obtain a perfectly sterile liquid (that is to say, one deprived of all living germs) by one of four methods: —

1. Filtering through some material whose meshes are sufficiently fine to arrest the smallest organisms. The only material really practicable for this purpose is the unglazed porcelain used by Pasteur and Chamberland.

2. Obtaining the liquid directly from the internal organs of one of the superior animals; the digestive tract being considered, for this purpose, an *external* organ. Pasteur's experiments have shown that the

[1] Abridged from an article by DR. HERMANN FOL of the University of Geneva, in *La Nature*.

tissues of such animals are the most perfect filters known, neither permitting the entrance, nor tolerating the existence, of any foreign material, unless the tissues are diseased.

3. Sufficiently prolonged exposure to a temperature of at least 110° C. This is the lowest necessary for the destruction of spores, although 80° C. is sufficient to kill bacteria in the growing condition. The length of the exposure must not be less than an hour: the longer the time beyond this, the greater the security.

4. Intermittent heating, invented by Tyndall, and much used in Germany. This consists in making the spores germinate, in order to kill the full-grown bacteria at 80° C. For this purpose, the vessels containing the fluid to be sterilized are kept at 20°-30° C. to favor the growth of the spores, and are every day raised to 80° C. for one hour, to destroy such bacteria as have become fully developed. This method takes much time, and its results are always uncertain. [This is the French point of view, but must not be accepted as that of the best authorities. — ED.]

Of all these methods, the third, that of destroying the germs once for all, is the one giving the greatest security and ease of manipulation. It has but one fault, that of coagulating all albuminous substances which can be solidified at the temperature of boiling water. [This fault is a very great one, and at once excludes the use of blood-serum as a culture-medium. — ED.]

The latest and best method for employing this process is as follows: The first thing is to close the vessels meant to contain the sterilized liquids with stoppers permeable to air. The method of doing this will be described later. The flasks are then kept at a temperature of 160° C. for at least three hours. If the temperature be higher, sterilization will occur sooner, but the cotton stoppers will be charred. The furnace in which this sterilization is done should be double-walled, but its form is unimportant. The flasks should be allowed to cool slowly to prevent breakage; and, as the rarefied air contracts, the air which enters is well filtered by the cotton plug.

The second step consists in preparing the sterilized liquid, and introducing it into the flasks. The *bouillon* of Miguel is the best we know of, and is this: Take of lean meat (beef) one kilogram, and boil it in four litres of water for five hours; skim it, and let it stand over night in a cool place; then take off the fat, and neutralize the fluid with caustic soda; filter, put in water up to four litres, and boil for ten minutes.

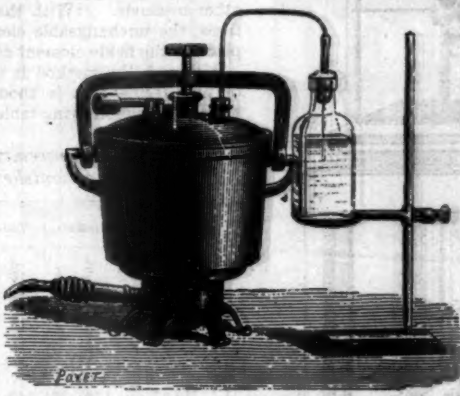


FIG. 1. — PAPIN'S POT, WITH THREE OPENINGS.

Prolong this second boiling to an hour, and do it in a Papin's pot, at 110° C., after putting in forty grams of common salt. Then the liquid, cooled, and passed through a double filter, is again placed in the Papin's pot for three hours, which completes the sterilization. Instead of this natural *bouillon*, the following may be used: —

	Grams.
Peptone (chemically pure)	5
Basic phosph. soda	10
Ammon. muriat.	5
Liebig's extract	5
Cane-sugar	20
Cooking-salt	3
Water	1,000

Boil, filter, and sterilize as above. The result depends upon the quality of the peptone. If a nutrient gelatine be desired, put from twenty-five to thirty grams of pure colorless gelatine into either of the above fluids before the last filtering. This last should then be done through a hot filter. The other manipulations are the same, except that the sterilization must not be prolonged more than an hour; for, if it is, the gelatine loses its power of solidifying. Agar-agar may be used instead of gelatine, and remains solid at 30° C. It is only partially dissolved in boiling water, but is completely so at the end of an hour at 110° C. in Papin's pot. Filter hot, and again sterilize at 100°

FIG. 2. — PRESERVATION TUBE.

FIG. 3. — STOPPER OF PRESERVATION TUBE, WITH TROCAR POINT.

—120° C. Agar-agar will stand any amount of prolonged heat.

The pot in which the sterilization is done has three openings (fig. 1). One is for the safety-valve; the second, for the thermometer, has a tube closed at the bottom to prevent pressure upon this instrument; and the third is conical, closed with a cork kept in place by a handle and thumb-screw. A metallic tube,

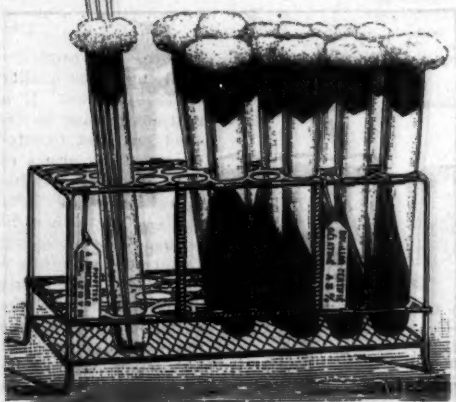


FIG. 4.—RACK FOR PRESERVATION TUBES.

bent twice, passes into the chamber. The free end is connected by rubber tubing, kept closed by a spring, to a short metal tube with a trocar point, and an opening near the extremity in the side.

After the fluid has been sufficiently sterilized, upon introducing the bent tube into the upper part of the chamber, and opening the spring, the vapor is forced out. Allow it to run for a few moments, heat the trocar end of the tube, work this through the cotton stopper of a sterilized flask, and the nutrient fluid will be gradually passed over into the flask.

FIG. 5. — CONICAL CULTURE-FLASK.

To obviate the difficulties in the way of piercing the ordinary cotton plug with safety, small test-tubes with a flaring mouth, and a hole in the bottom, are placed in the mouths of the flasks, with cotton outside and flax at their bottoms. Above the flax is a plug of cotton (fig. 2). The trocar point can be easily forced through the flax and the thin layer of cotton underneath, if the upper plug be removed (fig. 3); and this method seems to offer the easiest and most certain manner of filling the flasks or other vessels. For cultures, I prefer test-tubes placed in racks of iron wire (fig. 4), or conical flasks with flat bottoms (fig. 5).

Accidental contamination is the one thing to be avoided in these proceedings, which is attained by heating every thing used for sowing, etc., to 300° C.; the objection to this being the difficulty of getting the instruments cool enough not to destroy the germs which we wish to use, and at the same time not cool enough to take in impurities. Manual dexterity teaches much, but more vigorous measures are better still.

I first sterilize all my instruments in test-tubes with flax stoppers, through which they pass. Such are glass pipettes, pointed, with an opening at the

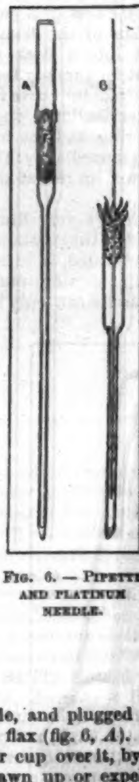


FIG. 6. — PIPETTE AND PLATINUM NEEDLE.

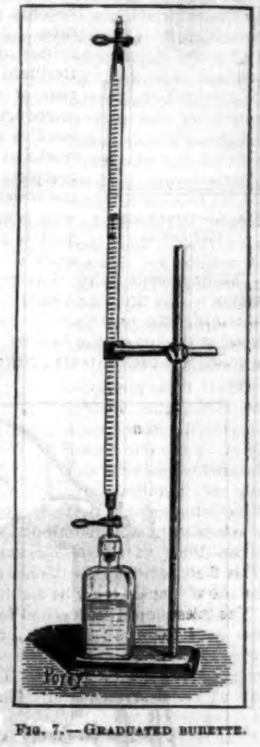


FIG. 7.—GRADUATED BURETTE.

side, and plugged at the other end with cotton-wool or flax (fig. 6, *A*). When in use, this end has a rubber cup over it, by means of which the fluid may be drawn up or expelled. For more solid materials, I use knitting-needles, or platinum wire in straight tubes with open bevelled ends (fig. 6, *B*), and, for sowing, push the point of the needle through the open end of the tube. In transferring a pure culture from one flask to another, these means are sufficient; but, with mixed cultures, separation of the various forms must be accomplished, which may be done by culture fluids or nutrient gelatine.

For fractional cultures in liquids, the principal

instrument needed is a round burette, tapering at both ends, and graduated so that the mark 100 is exactly at the lower orifice, and the mark 0 a few centimetres below the upper (fig. 7). On each extremity is placed a rubber tube closed by a spring. Before using, I disinfect the apparatus by passing sulphurous acid through it, and then attaching it to a Papin's pot filled with water at 110° C. for an hour. In fifteen minutes all trace of the sulphurous acid has disappeared, both rubber tubes are closed, their ends plugged with sterilized flax, and the burette left to cool. In cooling, a perfect vacuum is produced in the tube. I affix to the lower rubber tube a pointed canula, sterilized *at the time* by a current of steam or the flame, introduce it into a flask of *bouillon* kept for three or four weeks at 30° C. (to prove its complete sterilization), open the lower spring, and the burette is filled immediately: the fluid is allowed to rest at the mark 0.

FIG. 8.—GLASS CULTURE-FLASK.

The apparatus being thus prepared, a very dilute portion of the fluid, or a small piece of the substance containing the organisms to be separated, is introduced at the top of the burette. The dilution must be great; for the contents of the burette can only be distributed among twenty-five tubes, and more than two-thirds of these tubes must become inoculated in order to the success of the experiment. If it be desired to determine the number of germs in a given specimen of water, put a very minute quantity into the burette filled with sterilized *bouillon;* mix the two thoroughly, thus obtaining an equal distribution of the germs; introduce the canula of the burette, immediately after heating, through the plug of a sterilized tube; allow four cubic centimetres of the fluid to flow from the burette; and so on for twenty-five tubes.

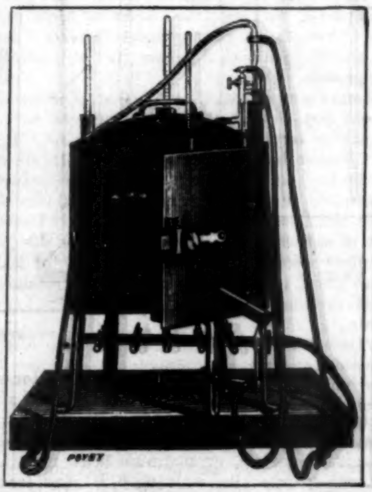


FIG. 9.—WIESNEGG STOVE.

If all the tubes become cloudy, it is because the amount of water used was too great; and this amount must be reduced until only a portion of the tubes show any sign of life. With water full of bacteria, the quantity to be used is too small for exact measurement; and then two burettes are used, the one full of water, and the other of *bouillon.* A drop of the suspected water is placed in the first, and then this dilution is used with the *bouillon*, as before. A simple arithmetical calculation then gives the approximate number of germs in a given quantity of water.

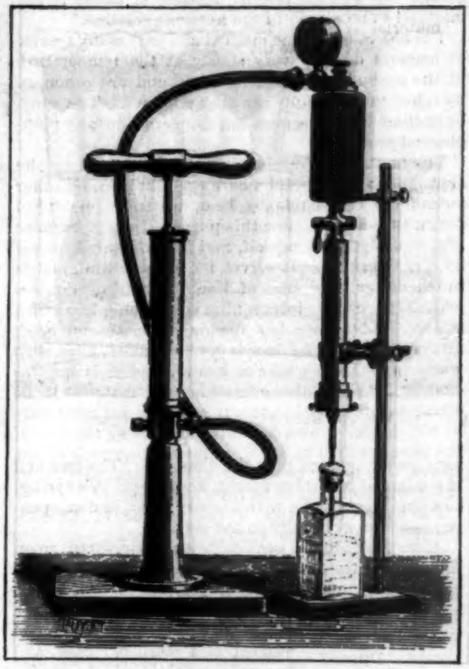


FIG. 10.—CHAMBERLAND'S FILTER.

The first experiments of Pasteur and Tyndall were imperfect in method; Miguel used a flock of cotton in a glass tube, through which he filtered the air, and then washed the cotton in sterilized *bouillon:* my improvement is to substitute a powder, soluble in the nutrient fluid, for the cotton; and for this purpose I use common salt, well sterilized. This salt may be turned into the burette, and the calculation made as before.

The results obtained by fractional culture are at the

best but approximate; but even these are better than the results from cultures scattered over gelatine surfaces. This method, however, is good as a preliminary, and is in brief as follows: A definite quantity of the suspected water is placed in a measure of nutrient gelatine; this is softened by heat, and the two are thoroughly mixed; and the gelatine is then allowed to harden in a test-tube, or in such a flask as is shown in the figure (fig. 8). The flat, thin surface thus obtained makes it more easy to count the colonies which will appear in a few days. For air-germs, the soluble powder spoken of above is the material to be placed in the nutrient gelatine.

The objections to the method are, that many species of bacteria develop very slowly at the temperature of the air and in a solid medium, and are obscured by other more rapidly growing colonies. The same objections hold in separating the germs in any pathological process.

The method of fractional sterilization used by the Germans is only useful where egg-albumen, or other substances coagulable by heat, are to be employed for culture-media. For this purpose I use a furnace (fig. 9) designed by myself, and manufactured for me by Mr. Wiesnegg. It serves its purpose well, and is much better than that of Koch. It is of double-walled copper, the intervening space being filled with water. This space has openings for thermometer and regulator. The door is double-walled, filled with water, and has its special heater, and it is kept at exactly 75° C. Tubes containing the material to be sterilized are placed in this furnace for one hour daily to kill the full-grown bacteria, and during the rest of the time are kept at 35° C. to favor the growth of the spores. In ten or twelve days the greater part of the tubes will be found to be fully sterilized.

Far better than this is the method of filtering through a substance sufficiently fine to retain all germs, successful results having been long obtained by Pasteur by filtering through plaster. Chamberland's method through porcelain is, however, the best (fig. 10), and is perfectly satisfactory provided the porcelain tube is good. This latter is difficult to obtain. Diluted egg-albumen and blood-serum may be easily filtered in this way, although slowly, under a pressure of from two to three atmospheres. Great care must, of course, be taken, to prevent the contamination of the material after it leaves the canula.

This method of sterilization is peculiarly appropriate for certain animal fluids whose chemical composition is changed by heat, but which it may be necessary to employ as culture-media for certain forms of bacteria.

TRANSPORTATION OF PETROLEUM TO THE SEABOARD.[1]

THE interest in the late project for forcing water for army purposes over the broken and elevated country between Suakin and Berber by means of pipes has called attention to the extent, importance, and utility of the pipe-lines in our own country, which convey the crude petroleum of the region lying between the Alleghanies and Lake Erie to the shores of that lake and the Atlantic seaboard.

The exploitation of these regions by means of artesian wells began about twenty-six years ago. By June, 1862, 495 wells had been sunk near Titusville, and the daily output was nearly 6,000 barrels, selling at the wells at from $4 to $6 a barrel. But as the production increased with rapid strides, the market-price fell with a corresponding rapidity, making the transportation charges to New-York City a considerable proportion of the total cost.

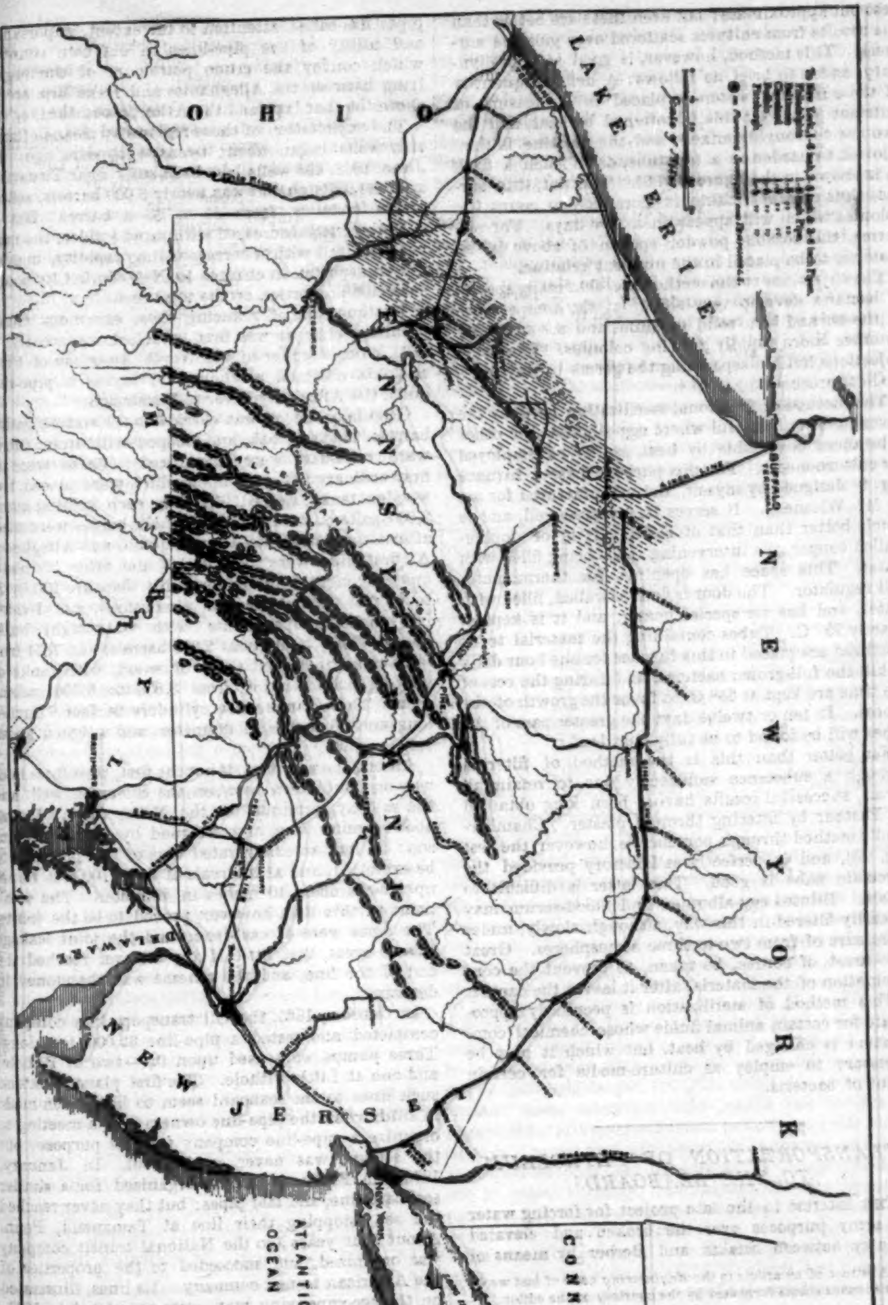
The question of reducing these enormous transportation charges was first broached, apparently, in 1864, when a writer in the *North American* of Philadelphia outlined a scheme for laying a pipe-line down the Allegheny River to Pittsburgh.

Originally the oil was carried in 40 and 42 gallon barrels, made of oak, and hooped with iron: afterward tank-cars were introduced. These were at first ordinary flat cars, upon which were placed two wooden tanks, shaped like tubs, each holding about 2,000 gallons. On the rivers, bulk-barges were also, after a time, introduced on the Ohio and Allegheny. At first these were rude affairs, and often of inadequate strength; but, as now built, they are 130 by 22 by 16 feet in their general dimensions, and divided into eight compartments, with water-tight bulkheads. They hold about 2,200 barrels. In 1871 iron tank-cars superseded those of wood, with tanks of varying sizes, ranging from 3,856 to 5,000 gallons each. These tanks were cylinders 24 feet 6 inches long and 66 inches in diameter, and weighed about 4,500 pounds.

Among the very first, if not the first, pipe-lines laid, was one put down between the Sherman well and the railway terminus on the Miller farm. It was about 3 miles long, and designed by a Mr. Hutchinson: he had an exaggerated idea of the pressure to be exercised, and at intervals of 50 to 100 feet he set up air-chambers 10 inches in diameter. The weak point in this line, however, proved to be the joints. The pipes were of cast-iron; and the joint leakage was so great, that little if any oil ever reached the end of the line, and the scheme was abandoned in despair.

In October, 1865, the Oil transportation company completed and tested a pipe-line 32,000 feet long. Three pumps were used upon it, — two at Pithole, and one at Little Pithole. The first plans to extend such lines to the seaboard seem to have been made in 1876, when the pipe-line owners held a meeting to organize a pipe-line company for this purpose; but the scheme was never carried out. In January, 1878, the Producers' union organized for a similar seaboard line, and laid pipes; but they never reached the sea, stopping their line at Tamanend, Penn. About four years ago the National transit company was organized, and succeeded to the properties of the American transit company. Its lines, illustrated on the accompanying map, were completed in 1880-

[1] Abstract of an article in the *Engineering news* of last week, from advance sheets furnished by the courtesy of the editor.



MAP SHOWING PIPE-LINES OF THE NATIONAL TRANSIT COMPANY. (Engineering news.)

81; and this company, to which the United pipe-lines have also been transferred, is said to have $15,000,000 invested in plant for the transport of oil to tide water. They operate a total of 880 miles of main pipe-line alone, ranging from 4 inches to 6 inches in diameter; or, adding the duplicate pipes on the Olean New-York line, we have a round total of 1,330 miles, not including loops and shorter branches, and the immense network of the pipes in the oil regions proper.

A general description of the longest line will practically suffice for all, as they differ only in diameter of pipe used, and power of the pumping-plant. As shown on the map, this long line starts at Olean, near the southern boundary of New-York state, and proceeds by the route indicated to tide water at Bayonne, N.J., and by a branch under the North and East River, and across the upper end of New-York City to the Long-Island refineries. This last-named pipe is of unusual strength, and passes through Central Park. The following table gives the various pumping-stations on this Olean New-York line, and some data relating to distances between stations and elevations overcome: —

Pumping-stations.	Miles between stations.	Elevation above tide.	Greatest summit between stations.
		Feet.	Feet.
Olean	–	1,490	–
Wellsville	28.20	1,510	2,400
Cameron	27.91	1,042	2,530
West Junction	29.70	911	1,917
Catatonk	27.37	860	1,708
Osborne	27.99	1,092	1,539
Hancock	29.86	922	1,873
Cohecton	26.22	748	1,854
Swartwout	28.94	475	1,478
Newfoundland	29.00	768	1,405
Saddle River	28.77	35	398

On this line two 6-inch pipes are laid the entire length, and a third 6-inch pipe runs between Wellsville and Cameron, and about halfway between each of the other stations, 'looped' around them. The pipe used for the transportation of oil is especially manufactured of wrought-iron to withstand the great strain to which it will be subjected. The pipe is made in lengths of 18 feet, and these pieces are connected by threaded ends and strong sleeves. The pipe-thread and sleeves used on the ordinary steam and water pipe are not strong enough for the duty demanded of the oil-pipe. Up to 1877, the largest pipe used on the oil-lines was 4-inch, with the usual steam thread; but the joints leaked under the pressure, 1,200 pounds to the square inch being the maximum the pipe would stand. This trouble has been remedied by the pipe of the present day, which is tested at the mill to 1,500 pounds' pressure, while the average duty required is 1,200 pounds. As the iron used in the manufacture of this line-pipe will average a tensile test strain of 55,000 pounds per square inch, the safety factor is about one-sixth.

The line-pipe is laid between the stations in the ordinary manner, excepting that great care is exercised in perfecting the joints. No expansion joints or other special appliances of like nature are used on the line, so far as we can learn; the variations in temperature being compensated for, in exposed locations, by laying the pipe in long horizontal curves. The usual depth below the surface is about 3 feet, though in some portions of the route the pipe lies for miles exposed directly upon the surface. As the oil pumped is crude oil, and this, as it comes from the wells, carries with it a considerable proportion of brine, freezing in the pipes is not to be apprehended. The oil, however, does thicken in very cold weather, and the temperature has a considerable influence on the delivery.

A very ingenious patented device is used for cleaning out the pipes, and by it the delivery is said to have been increased in certain localities fifty per cent. This is a stem about 2½ feet long, having at its front end a diaphragm made of wings which can fold on each other, and thus enable it to pass an obstruction it cannot remove. This machine carries a set of steel scrapers somewhat like those used in cleaning boilers. The device is put into the pipe, and propelled by the pressure transmitted from the pumps from one station to another. Relays of men follow the scraper by the noise it makes as it goes through the pipe, one party taking up the pursuit as the other is exhausted. They must never let it get out of their hearing, for, if it stops unnoticed, its location can only again be established by cutting the pipe.

At each station are two iron tanks 90 feet in diameter and 30 feet high. Into these tanks the oil is delivered from the preceding station, and from them the oil is pumped into the tanks at the next station beyond. The pipe system at each station is simple, and by means of the 'loop-lines' before mentioned, the oil can be pumped directly around any station if occasion should require it.

The engines vary in power from 200 to 800 horse-power, according to duty required. They are in continuous use, day and night, and are required to deliver about 15,000 barrels of crude oil per 24 hours, under a pressure equivalent to an elevation of 3,500 feet.

The enterprise has been so far a great engineering success, and the oil delivery is stated on good authority to be within two per cent of the theoretical capacity of the pipes. From a commercial stand-point, the ultimate future of the undertaking will be determined by the lasting qualities of wrought-iron pipe buried in the ground, and subjected to enormous strain. Time alone can answer this question.

THE STUDY OF BACTERIA.

THIS is the best summary of the methods best adapted for bacterial research that has as yet been published. It contains little that is

Die methoden der bakterien-forschung. Von Dr. FERDINAND HUEPPE. Wiesbaden, *Kreidel*, 1885. 8+174 p., illustr. 8°.

not necessary; and yet, with this book in hand, the beginner may feel sure of not going astray, if he follows the directions laid down in it.

The book opens with a brief statement of the various classes of bacteria, which is followed by a consideration of the theory of spontaneous generation, and the principles upon which sterilization depends. These latter are very well and briefly stated. The various methods of sterilization are spoken of and explained, and due prominence is given to the method of 'discontinuous' or 'intermittent' sterilization so much used at present.

The second chapter is devoted to the various forms of bacteria, and to an elucidation of the microscopic technique. The method of observation of unstained and stained bacteria is fully shown, and the general principles of the aniline colors are explained. Here are brought together, in a convenient form, all the various staining-fluids of Koch, Ehrlich, etc., with their formulae. The various accessories in the way of reagents and instruments, are, of course, included.

The importance of the bacillus of tuberculosis in furnishing a conclusive method for the diagnosis of this disease leads the author to devote a number of pages to the methods of staining this organism; and all workers in this branch of investigation will be glad to find the full account of the methods of staining *spores* which is given. The method of treating sections of the tissues for purposes of showing bacteria contained in them closes this portion of the work. The various culture methods and materials are clearly given; and the formulae for the various nutritive media, are, of course, added. The advantages of the solid over the fluid cultures are so manifest as to need but a very few words; but these advantages are here so clearly set forth, that any sceptic may be convinced if he will but read the evidence.

Something is said of the saprophytic and parasitic bacteria, and a summary of the general biological problems involved is given.

The book closes with a few words on the special investigation of earth, air, and water.

All the more important implements needed are figured in very good woodcuts, and there are two lithographic plates showing various culture colonies and stained bacteria.

The work is a good one, and well done. It is especially needed at the present time of interest in all that belongs to bacteriological research, and will certainly prove useful to any one interested in the subject who is able to translate easy German.

SAPORTA'S PROBLEMATICAL ORGANISMS OF THE ANCIENT SEAS.

FOSSIL algae are proverbially difficult and unsatisfactory subjects for study. Usually of irregular and variable forms, without definite and characteristic surface-markings, and composed only of cellular tissue which has entirely disappeared, they have left shadowy outlines, or mere casts, that afford only the most general and superficial characters for comparison among themselves or with living plants: hence there must be considerable uncertainty in regard to the botanical relations of even those best preserved; while those which are more obscure are liable to be, and have been, confounded with tracings made by floating objects, the tracks or burrows of annelids, with sponges, alcyonarians, medusae, and other soft-bodied and perishable organisms. Yet the supposed remains of seaweeds are so abundant in rocks of all ages, from the Cambrian up, that they could not be ignored; and a large number of more or less distinct imprints, some of which are unmistakable algae, have been figured and described by Sternberg, Brongniart, and other writers on fossil botany who have followed them. Count Saporta is one of the latest and most learned of these writers, and one who has done much excellent work in his studies of the mesozoic and tertiary plants of France. In his valuable and voluminous contributions to the 'Palaeontologie Française,' and in his 'L'évolution du règne végétal,' he has given a large number of figures and descriptions of what he supposed to be fossil seaweeds, and has attempted a more thorough review of this department of fossil botany than any one else has ventured on. As to the character of much of his material, there can be no reasonable doubt; but some of his specimens are too obscure to warrant any very positive assertions, and in some cases his conclusions have been questioned.

A somewhat sweeping criticism of Saporta's work was recently made by Mr. A. G. Nathorst (*Bull. de la soc. géol. de France*, 3 sér. t. xi. p. 452), who considers that most of his so-called algae are simply casts of tracks or other impressions mechanically made on the sea-bottom.

The work now published is largely a defence of the views heretofore held by Saporta, and it contains figures and descriptions of a number of the casts and impressions which have been the subjects of controversy. Among other things noticed are those peculiar and enigmat-

Les organismes problématiques des anciennes mers. Par le MARQUIS DE SAPORTA. Paris, 1884. 4°.

ical objects which have been found in all countries, and have been described under the names of Cruziana, Rusophycus, etc. These are usually casts of impressions in what was the slimy surface of a mud sheet, sometimes an inch, sometimes a foot or more, in length, by from one to two inches in width. A deep sulcus traverses the middle, and the surface is marked by divergent and parallel, or curiously reticulated and inosculating ridges.

First noticed by Dr. Locke in Ohio in 1838, and named by Vanuxem in 1842 Fucoides biloba, by D'Orbigny in 1842 Cruziana, by Rouault in 1850 Fraena, and by Hall in 1852 Rusophycus, they have been since referred to under one or another of these names by most writers on geology. By the authors mentioned they were regarded as the impressions of seaweeds; but by Dawson, Lapparent, Briart, Hebert, Hughes, Nathorst, and J. F. James they have been considered the tracks of animals. Saporta, in the work under consideration, discusses their character and origin at great length. He pronounces them fucoids, and calls them Bilobites, taking the name from De Kay, and referring for authority to the first volume of the 'Annals of the New-York lyceum of natural history' (1824), where a paper is published by De Kay, "On the organic remains termed 'Bilobites' from the Catskill Mountains," illustrated with one plate and four figures.

On referring to this paper, every American geologist will at once recognize in the fossil described, Conocardium trigonale, a characteristic mollusk of the corniferous limestone and the Schoharie grit. When the suture of this shell is exposed, the carinated valves present an appearance which led our earlier geologists to regard it as a crustacean allied to the trilobite, but distinguished by having two lobes instead of three. De Kay, though retaining the term 'Bilobites,' recognized its molluscous character, and its resemblance to Cardium. From these facts it will be seen that Bilobites of De Kay has no relation whatever to Fucoides biloba of Vanuxem, or Cruziana of D'Orbigny, and the name has been erroneously applied by Saporta. The descriptions of Vanuxem and D'Orbigny bear the same date; but, the old genus Fucoides having been broken up and abandoned, D'Orbigny's Cruziana would seem to be the proper name for these singular objects. Hall's name, Rusophycus (called Rysophycus by Hughes as being more correct), is apparently a synonyme of Cruziana, and, published later, must be superseded by that.

Though we have thus obtained a name for these objects, their true character is as far from being demonstrated as ever, nor does it seem probable that the present diversity of opinion will soon be harmonized. Every one who has seen much of the exposures of shallow-water sediments, shales, and flagstones, will concede that many of the so-called fucoidal markings are of mechanical origin, and will accept Nathorst's view that such casts as Eophyton and Panescorsea are inorganic. Where the cast consists of a number of divergent ridges springing from a common stem like branches from a trunk, such as Vexillum Sap. (which, however, can hardly be distinguished from Licrophycus of Billings), the conclusion seems inevitable that the cast is organic, and the form is rather that of a plant than a sponge.

Although so far resulting in little demonstration, the discussion in which Saporta and Nathorst have taken the leading parts has excited much interest, and has been productive of an important series of experiments and observations. Doubtless in this, as in many other discussions, the truth will be found to lie between the views of the opposing leaders, yet science will be advanced by the stimulus to inquiry furnished by these very differences.

J. S. NEWBERRY.

PRONUNCIATION.

MEETING a book of this kind, admitting its possible utility, one naturally asks whether the pronunciations recommended are correct, with allowance for admissible variations, whether the description and representation of sounds are exact and clear, and whether the list of words likely to be mispronounced is judiciously made. The first and last of these questions suggest no severe criticism of this book, unless one considers only matters of detail. We mention only one. Paragraph 51, in the introduction, should be changed so as to make it clear that by 'antepenultimate vowel' is meant that in the Latin words referred to, not in the English, as is now absurdly said.

The second question shows the weakness and unpractical plan of the book. Passing by the introduction, which shows some careful observation, but has several hazardous assertions, we come to the body of the book. Here each page contains two columns, — on the right hand, the words in alphabetical order, but

A handbook of pronunciation. By LEWIS SHERMAN. Milwaukie, *Cramer, Aikens, & Cramer, pr.*, 1885. 174 p., illustr. 8°.

not perfectly so (witness *consols*); on the left hand, the same words, in the same spelling, but with various devices to show the pronunciation, such as the use of accents, acute and grave, heavy type for some letters, and smaller type for silent letters. The notation used is a new one, and the final result far from being readily intelligible. The proper course would have been to minimize the inconvenience to the user by making the left-hand column as simple as possible, using always only one sign for the same sound, and omitting silent letters altogether. If all the words are respelled solely to show their pronunciation, there is no excuse for not spelling phonetically.

NOTES AND NEWS.

THE local committee of the American association, which will hold its thirty-fourth meeting in Ann Arbor during the week beginning Wednesday, Aug. 26, announces that the general sessions will be held in University Hall, while rooms for the sectional meetings will be assigned in different buildings on the university grounds. The offices of the permanent and local secretaries and of the various committees will be established in the immediate proximity, together with an association post-office; and all letters, telegrams, and express packages bearing the letters 'A. A. A. S.' will be delivered close at hand. The university offers the use of its rooms for any lectures, or specially illustrated papers, which may be authorized by the standing committee. Sectional papers demanding experimental illustration may be supplemented by the use of the apparatus at hand. The university will furnish electricity, either from a dynamo, from a storage-battery, or from primary batteries, as may be needed by members reading papers on electrical subjects. Opportunity will also be given any member desirous of making an exhibit of apparatus, minerals, or scientific specimens of any kind, to properly display the same.

The committee is not yet ready to announce complete arrangements with the railways, but they state provisionally that over most of the lines return tickets will be furnished for one-third of the regular price to all who have paid full fare over the same line. Ann Arbor is situated on the lines of two railways, —the Michigan central, and the Toledo, Ann Arbor, and northern Michigan; and a special through train, for the exclusive use of members of the association, will be run by the former if a sufficient number desire, leaving Buffalo on Tuesday morning, Aug. 25, stopping for an hour or two at Niagara Falls, and reaching Ann Arbor in the evening of the same day. The two hotels at Ann Arbor are the Cook House and the Franklin House, where members will be accommodated at two dollars a day. A large number of rooms, with prices varying from fifty cents to a dollar a day, have also been engaged in private houses near the university grounds, where, to accommodate those not offering board as well, a restaurant sufficient to accommodate three hundred persons at once will be established, at which, breakfast, dinner, and supper will be furnished at the uniform price of fifty cents. Private hospitality is also liberally promised by many citizens; and there is no question of sufficiency of accommodation, as most of the two thousand students who live in the city during term time will be absent on their vacation.

An evening reception on a day not specified will be given the association at the court-house, together with a lawn-party on the university grounds at the close of one of the regular sessions. The excursions committee has nearly completed arrangements for a trip, free of all expense, to the Saginaw valley, including a steamboat ride down the river, and view of the cities of Saginaw, East Saginaw, Bay City, and West Bay City, and the enormous industries in salt and lumber manufacture which have given the Saginaw valley a world-wide celebrity. This valley produces annually a billion feet of lumber, and the excursionists will see half a billion piled on the docks. In conjunction with these vast lumber operations will be seen the production of salt on a scale unequalled in the world, and employing the various improved processes. The committee has also arranged for excursions to Detroit and Mackinack Island, with side trips to Sault Ste. Marie, Pectoskey, and Marquette. Members wishing to make any special inquiries or arrangements should address Prof. J. W. Langley, local secretary, Ann Arbor, Mich.

—Matusoffski and Nikitine, well known for their travels in China and Sakhalin, have recently finished a new map of China; that is to say, of the Middle Kingdom, with the region bordering upon it. This chart is on the scale 1:4,200,000, and is the best yet issued in point of execution. Paderin, Uspenski, and Sheveleff have served as a committee on the orthography of proper names, with Professor Vasilieff as umpire in doubtful cases. It extends from the western borders of Corea to the Yung-ling Mountains, and between latitudes 16° and 45° north.

—The *Annuaire de Turkestan* for 1885 has just been issued by Messrs. Sokoloff and Lakhtin. Its contents are of unusual interest in connection with recent events, and comprise, among other things, a chronology of historical events from 1155 to 1884; a memoir on the Merv oasis and on the route between Khiva and the Caspian; notes on the Amu Daria; a description of Ferghana, of the museum at Tashkent, of the fisheries of Turkestan, and an account of public instruction in Turkestan.

—A special chair of geology has just been established in the Indiana university, and Prof. J. C. Branner of the Geological survey of Pennsylvania has been chosen to fill it. Professor Branner was for six years assistant geologist to the Imperial geological survey of Brazil. Prof. J. P. Naylor of Indianapolis has been elected to the chair of physics.

—Dr. Hermann Roskoschny has projected a series of geographical manuals on European and especially German colonization, under the title 'Europas Kolo-

nien.' Under the same editor has just been issued the first part of a hand-lexicon of Africa by Paul Heichen, to comprise thirty parts, octavo, at fifty pfennige each, to be profusely illustrated, and to contain retrospective as well as actual information. It is well printed, and is published by Grossner & Schramm, Leipzig.

— A long-delayed letter from the bishop of central Oceanica gives details of the honors rendered by the civil and religious authorities to the relics of the companions of La Perouse. These last survivors of that unfortunate expedition were massacred by the Samoans on the Islet of Tutuila on the 11th of December, 1787. Father Vidal, of the mission, had been searching twelve years for the remains, which were finally identified in October, 1882. The authorities in France, on being notified, caused a beautiful mortuary tablet to be prepared, and forwarded to the admiral on duty at that station. A monument was erected, upon which the tablet was fixed, and a small chapel built near it. The whole was dedicated by Bishop Lamaze and Commandant Fournier, of the French navy, with solemn ceremonial and minute-guns on the ninety-seventh anniversary of the event.

— The Société de géographie has elected Mr. de Lesseps, the present incumbent, to its presidency for 1885–86, and Messrs. Himly and Bischoffsheim, vice-presidents.

— A portion of the work of Protestant missionaries in China, which has attracted little attention, says *Nature*, and which, nevertheless, is of great importance, is the preparation of school and text books in Chinese. For this purpose Protestant missionaries of all nationalities and denominations have united. At a general conference held in Shanghai in 1877, a committee of eight of the leading missionaries was appointed to superintend the preparation and publication of the series. The work has now been going on for eight years, and the committee are able to report that over forty works have been issued, and that thirty more are in various stages of progress. In addition, four numbers have been issued of an 'outline series' compiled with the object of supplying Chinese schools with small and simple treatises on scientific subjects at cheap rates, suitable either as elementary school-books or as popular tracts for general distribution. What 'cheap rates' mean, will appear from the fact that the outlines of astronomy costs rather less than a penny; those of political and physical geography and geology, about twopence each. The larger works embrace anatomy in five volumes, ancient religions and philosophies in three, arithmetic, charts of astronomy, birds and mammals, with accompanying handbooks (these charts, from the prices, are obviously intended for the walls of schools), chemistry, political economy, geology, universal history, international law (a translation of Bluntschli, it appears), zoölogy, and several on biblical topics. Those in preparation include treatises on various branches of elementary mathematics, botany, ethnology, hygiene, jurisprudence, logic, mathematical physics, meteorology, mineralogy, philology, and forty wall-charts with accompanying handbooks. These works, it must be remembered, have first to be compiled with a special view to the knowledge usually possessed by Chinese children, and then to be translated, representing in each case two distinct tasks. That the missionaries in China and elsewhere have schools where they teach the young, is well known; but it will probably be a surprise to many to find, that, in addition to their ordinary labors as preachers and teachers, the missionaries in China have had to undertake a task of such magnitude as the creation of school literature on all subjects of human knowledge, from arithmetic to jurisprudence, and from anatomy to logic. The statement on this subject is taken, it should be added, from the *Chinese recorder* of Shanghai, a magazine which is itself a monument to the learning and enterprise of Protestant missionaries in China.

— The second edition of Macfarlane's 'Geological railway guide,' first published in 1879, is now in active preparation. As its advance depends on co-operation from many state geologists and others, it is of necessity somewhat leisurely; but substantial progress is marked by thirty preliminary pages, which describe the Dominion of Canada, prepared by G. M. Dawson; and, if the rest of the work is up to this high standard of detail, it will be a great improvement on its valuable predecessor. The notes are full, and serve an excellent purpose. For example: under St. Hilaire station, Grand Trunk railway, we find, "Beloeil Mountain, one of the remarkable igneous protrusions which penetrate the flat-lying Silurian rocks of the St. Lawrence valley, may be visited from this point. The mountain is partly composed of augite syenite, and partly of nepheline syenite. An excellent summer hotel on the mountain." Again, at Thorold, "Good section of Clinton and Niagara in cutting of Welland canal. Fossils. A band of argillaceous limestone eight feet thick in the Niagara yields an excellent cement."

— The ordnance survey of the United Kingdom has issued an interesting report on the progress made to the end of 1884. Scotland and Ireland have been completed, and maps of these countries on the six-inch scale have been published. In Wales, Pembroke, Carnarvon, and Anglesea alone remain to be surveyed. It is hoped that the whole of the kingdom may be finished by the year 1890.

— Professor Hermann Fol has made a most valuable contribution to the resources of the histologist through the publication of the first part of his 'Lehrbuch der vergleichenden mikroskopischen anatomie,' — a treatise which ought to be in the hands of every morphologist and microscopist. The first part is entirely devoted to technique, and is so thorough and exhaustive, and done with so much critical acumen, that it surpasses all its predecessors. Sensible and practical directions for the use of the manifold instruments and operations of the histologist are given. The author has added also many valuable explanations and criticisms, and describes a number of new implements and methods devised by himself.

The present part contains the latest methods, and cites the literature very fully, and may be bought separately by those who wish. Part second will treat of the cell and the structure of unicellular animals; part third, of the ectoderm and its derivatives in the metazoa; part fourth, of the entodermal and mesodermal organs, — the whole to make a volume of some six hundred and fifty pages.

— According to the *Colonies and India*, Baron F. von Müller, K.C.M.G, has issued, under the auspices of the Victorian government, a second supplement to his systematic census of Australian plants. It appears from the information now published, that, whilst the known plants of Australia and Tasmania are about 9,000, they occur in the following proportions in the respective colonies: viz., western Australia, 3,455; Queensland, 3,457; New South Wales, 3,154; northern Australia, 1,829; Victoria, 1,820; South Australia, 1,816; and Tasmania, 1,023. The progress of botanical discovery in Australia within the last quarter of a century has been very marked; and the colonies are mainly indebted to Baron Müller for this result. He, with the late Mr. Bentham, prepared and published the seven volumes of the 'Flora Australiensis.'

— Dr. Fischer, who lived for seven years as a doctor in Zanzibar, has published a book on the colonization of tropical Africa, called 'More light on a dark quarter of the world;' also a report of his journey from Pangani to Lake Naawascha, undertaken for the Hamburg geographical society.

— According to *Nature*, the British consul at Leghorn, in his report for the past year, makes some interesting observations on coral in the Mediterranean. Some centuries back the Mediterranean coral fisheries were carried on exclusively by the Spaniards, and the principal establishments engaged in the manufacture of coral ornaments were in the hands of Jews residing in Spain. Towards the close of the sixteenth century, to escape the persecutions to which they were exposed, a large number of these merchants removed to Leghorn, in order to enjoy the secure asylum afforded by the liberal enactments of Ferdinando di Medici. Crews were obtained from the Neapolitan coast, principally from Torre del Greco: hence this place, at an early period, became the chief seat of the coral fishery; and most of the boats engaged in it are still fitted out at that port, although the manufacture of coral ornaments and beads is carried on principally at Leghorn and Genoa. These ornaments are met with in almost every part of the world; and in many countries, even in Europe, coral is believed to be possessed of a peculiar charm. In Asia and Africa it is regarded with a sort of religious veneration, while in India it is largely used for the adornment of corpses when prepared for cremation. But the present situation of the coral trade is disastrous. In 1880, a coral bank several kilometres in length was discovered near the island of Sciacca, on the coast of Sicily, and consequently the yield of raw material has been far in excess of the demand, and the reef is still very far from being exhausted. A great depreciation in value has ensued, and, as a consequence, an extensive trade has sprung up in coral with Africa, where the natives now purchase coral ornaments in place of glass beads of Venetian and German manufacture. The raw coral comes from Naples, and is worked at Leghorn by women into beads, British India and Egypt being the chief customers for them.

— Mr. Shelford Bidwell has read a paper before the Royal society, on the changes produced by magnetization in the length of rods of iron, steel, and nickel. He finds that the length of an iron rod is increased by magnetization up to a certain critical value of the magnetizing force; and, if that is passed, the elongation is diminished in proportion as the magnetizing force increases. The amount of the maximum elongation appears to vary inversely as the square root of the diameter of the rod. In soft steel, magnetization produces elongation; and, with hard steel, the critical value of the magnetizing force becomes very high. In soft steel a temporary elongation, once produced, may be maintained by a magnetizing force too small in itself to produce any elongation. Nickel continues to retract with magnetizing forces far exceeding those which produce the maximum elongation of iron. The greatest observed retraction of nickel is more than three times the maximum observed elongation of iron, and the limit has not yet been reached.

— Prof. H. A. Hazen has prepared a signal-service note (no. xx.) on the thunder-storms of May, 1884, in which he gives a brief statement of the results obtained from the volunteer observations on these storms, gathered on special cards from persons in all parts of the country. It is illustrated by maps for May 18 and 19, showing the advance of the thunder-storm area for these days. The conclusions presented are, 1°, hail-falls occur ordinarily with a pressure much below the normal, and in a position two or three hundred miles south-east of the centre of barometric depression (cyclonic centre); 2°, thunder-storms advance from west to east and south-east, generally accompanying a cyclonic depression in its south-east quadrant, four or five hundred miles from the centre; 3°, their action seems to die down at night, and begin again in the morning, and often spreads in a fan-shape to south-east and east; 4°, the velocity of the thunder-storm's advance is greater than that of the accompanying cyclonic depression. Description of the simple method of observation is added, and it is stated that more observers are still desired. Franked cards for mailing records will be supplied on application to the chief signal officer of the army, Washington.

— Mr. E. W. Maunder, assistant in charge of the spectroscopic work of the Royal observatory, Greenwich, is giving, in the current numbers of the *Observatory*, a paper on the motions of stars in the line of sight, as determined by spectroscopic methods. He remarks, that if the definition attributed to Bessel be a correct one, — that 'astronomy is the study of the movements of the heavenly bodies,' — spectroscopy had no claim to be regarded as a branch of astronomy,

until Dr. Huggins obtained his first measure of the displacement of the *F* line in the spectrum of Sirius, and thus proved that it was possible to ascertain the speed with which the star was moving in the direction of the visual ray,—an observation which deserves to rank in importance with the first detection of the proper motions of stars, or the first determination of their annual parallax, or even somewhat higher as being more entirely a novel enterprise.

—E. Revillout, the French Egyptologist, has nearly completed an exhaustive report on the demotic documents in the British museum which have been discovered in the course of the destruction of some Coptic houses in Lower Egypt. These demotic *ostraka* include a great number of receipts for taxes, some being of the Roman period. Revillout points out that one of the demotic *ostraka* preserved in the Louvre is composed in exactly the same formula as those written in Greek during the second year of the reign of Caligula, and the thirteenth year of Nero. Other analogous examples are among those in the British museum. The most interesting of the *ostraka* submitted to Revillout are of the Ptolemaic period, amongst which occur several bilingual texts of considerable importance. One of these decides a great question about money; and another example is a receipt, payable in corn, of a kind up to the present time only known from the Greek texts, and demonstrating the validity of theories with regard to measures hitherto held as provisional only. Other *ostraka* in the collection record oaths taken about crops, the succession of property, and accusations of thefts from the catacombs, as well as a demand for the liberation of a slave, and an instrument for the delivery of certain property, the manner being recorded in which a house was left by its owner.

—The students of the Kansas State agricultural college at Manhattan are planning a natural-history expedition during the summer in the west. The field of their operations will lie between the 100th and 150th meridians.

—The report of the proceedings of the Reale academia dei lincei, Rome, as contained in *Nature*, cites Professor Tacchini's communication on the hydrogenic protuberances of the sun, observed at the Royal observatory of the college of Rome during 1884. In continuation of his previous note to the effect that 1884 must be considered as a year in which the phenomena of the chromosphere had attained their maximum development, he presented the results of observations on two hundred and forty-two days, from which it appeared that the number of the protuberances increased from March to October. In order to get rid of the anomalies which are met with in various observations, and to obtain a curve representing the course of the phenomena in the period 1880–84, Professor Tacchini has taken as monthly means the means of three months. The corresponding curve shows three culminating points, or periods of maximum activity: viz., July, 1880; September–October, 1881; and March, 1884,—which last is the highest in the whole series. The maximum of the protuberances follows that of the sun-spots; and recent observations make it probable that the present year will be one of greater activity in the chromosphere and solar atmosphere.

—Prof. F. Jeffrey Bell will in future edit the *Zoölogical record*.

—Prof. H. L. Cohn, in his pamphlet 'Ueber den beleuchtungswerth der lampenglocken' (Wiesbaden, 1885) describes a long series of determinations of the relative values of various forms of lamp-shades. The method pursued was to measure the brightness of white paper lying on a table over which the source of artificial light was suspended at a given distance, by means of a Weber photometer. As one would anticipate, the general effect of a shade is to increase very greatly the illumination immediately under the light, and not modify it notably at an angular distance greater than forty-five degrees from this region. The last section of the pamphlet, which deals with the illumination required for easiest use of the eyes, is of the most general interest. Taking as a measure of the value of the illumination in this sense the number of lines which can be read from a newspaper in a minute, and as the unit of illumination that of a normal candle at a perpendicular distance of a metre from the paper, he finds that the best illumination is not less than fifty such units. Since even a fifth of this illumination is very rarely secured, except immediately under a lamp provided with a good shade, the author emphasizes the conclusion that few school-children work in a satisfactory light.

—The Swiss geologist and alpinist, Horace Bénédict de Saussure, the first to make the ascent of Mont Blanc (Aug. 3, 1787), is to have erected in his honor a statue in the village of Chamounix, from which point the ascent was made. It will be inaugurated on the centenary of his ascent. During the convention of the Alpine clubs at Chamounix year before last, the president of the section of the Jura, Vézien, called the attention of the alpinists to the fact that no statue in honor of the first of their number had yet been erected, and suggested that Chamounix was a suitable place for such a monument. This proposition was received with great applause; and, by a happy coincidence, at almost the same hour the president of the Swiss republic issued a decree authorizing the commune of Chamounix to accept a legacy of four thousand francs which had been made by a Mr. Chenal of Sallenches, according to a will drawn up as long ago as 1834. Mr. Chenal died in 1881; and the execution of his will has only now been accomplished. A committee has been formed to carry out the wishes of the legacy, which simply requires the erection of a monument in granite by some approved architect, with the inscription, 'À Monsieur Bénédict de Saussure, Chamounix reconnaissant.' This committee, which among others consists of Messrs. Daubrée of Paris, Alphonse Favre of Geneva, and the presidents of the Turin section and the Florence section of the Italian Alpine club, and the first president of the Austrian Alpine club, will endeavor to increase the sum, in order to erect a worthy monument. A subscription has been opened by the *Journal de Genève*, from which these facts are taken.

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